

AMENDMENTS TO THE SPECIFICATION:

Please replace the paragraph beginning at page 5, line 15, with the following rewritten paragraph:

--The object of the present invention is achieved, for combustion engines, by means of a method ~~according to the preamble of patent claim 1, said method being~~ characterized in that the liquid is heated to such an extent that, at the moment of introduction thereof, it has a temperature that is below the temperature of the medium at the moment of introduction of the liquid.--

Please replace the paragraph beginning at page 5, line 22, with the following rewritten paragraph:

--The object of the present invention is achieved, for compressors, by the method ~~according to the preamble of patent claim 2, said method~~ being characterized in that the liquid is pressurized and heated, before it is introduced into the compression chamber, to such an extent that at least a part of the droplets of the spray explodes spontaneously upon entrance into the compression chamber. All known methods according to prior art are focused on combustion engine applications. It seems as though prior art is fully focused on what kind of advantages can be obtained through the type of cooling ~~claimed in patent claim 2~~ in a combustion process, but not in a pure compression process. The invention, ~~as defined in patent claim 2,~~ is

therefore more generally defined than the combustion engine implementation which is defined in patent claim 1.--

Please replace the paragraph beginning at page 6, line 15, with the following rewritten paragraph:

--According to preferred embodiments of the method according to patent claim 2, the liquid is, preferably, pressurized to such an extent that, at the moment of introduction thereof, it has a steam pressure that is above the pressure that, at the moment of introduction, exist in the compression chamber. Further, it is preferred that the liquid is heated to such an extent that, at the moment of introduction thereof, it has a temperature that is above the boiling point of the liquid for the temperature and the pressure that, at the moment of introduction thereof, exist in the compression chamber. It is also preferred that the liquid is heated to such an extent that, at the moment of introduction thereof, it has a temperature that is below the temperature of the medium at said moment of introduction.--

Please replace the paragraph beginning at page 9, line 18, and the table which follows the paragraph, with the following rewritten paragraph and table:

--The principal basis of the invention can be seen in table 1. In column A there is shown some different pressures (bar), by adiabatic compression of air, where the air pressure before compression is 1 bar and the temperature is 273 K. Kappa is  $\gamma$  1.4. In column B, the temperature (K) is shown for the

compressed air with the different pressures according to column A. In column C the boiling point temperature (K) of the water is shown for the different pressures according to column A. The boiling point temperatures of the water for the different pressures are ocularly retrieved from steam pressure curves. Column D shows the pressurisation which is necessary for preventing the water from boiling at the temperature according to column B.

A	B	C	D
(bar)	(°K)	(°K)	(bar)
<del>20</del>	<del>642,5</del>	<del>485</del>	<del>210</del>
20	642.5	485	210
<del>10</del>	<del>527,2</del>	<del>453</del>	<del>40</del>
10	527.2	453	40
<del>6</del>	<del>455,6</del>	<del>432</del>	<del>10</del>
6	455.6	432	10
<del>5</del>	<del>432,5</del>	<del>423</del>	<del>6</del>
5	432.5	423	6
<del>4,5</del>	<del>419,8</del>	<del>420</del>	<del>4,5</del>
4.5	419.8	420	4.5
<del>4</del>	<del>405,7</del>	<del>417</del>	<del>3</del>
4	405.7	417	3
<del>3</del>	<del>373,8</del>	<del>406</del>	<del>1</del>

3                    373.8      406                    1--

Please replace the paragraph beginning at page 10, line 16, with the following rewritten paragraph:

-Table 1 shows that there is an intersection, marked with bold face, at approximately  $[[4,5]]$  4.5 bar. At lower pressures, the boiling point temperature of the water is above the temperature of the compressed air while, simultaneously, the pressurisation necessary in order to prevent the water from boiling is lower than the pressure of the compressed air. At pressures above  $[[4,5]]$  4.5 bar, the boiling point temperature of the water is lower than the temperature of the compressed air while, simultaneously, the pressurisation necessary in order to prevent the water from boiling is higher than the pressure of the compressed air. This is the basis for the inventive concept. During injection, spraying, of the water into the medium, which is air or gas, to be compressed, the water should be pressurized and heated to a temperature that will result in a fierce boiling, or explosion, of the water, resulting in a very fine division thereof to water droplets so small that a sufficiently large cooling surface area is obtained, such that heat can be drained off through the heating of the water droplets and/or through an evaporation. As the steam pressure is higher than the compression pressure, an exploding action is achieved on the water as the latter is depressurized at the moment of entrance into the medium under compression. The atomization has been allowed since

the water has been supplied with heat before being introduced into the medium to be compressed. It is a feature of the invention that heat, which otherwise would be lost through, for example, exhaust gases and/or a cylinder cooling or in other ways in other contexts, also called waste heat, is used for the heating of the water before the latter is supplied to the medium to be compressed. This can be accomplished through a heat exchange between the combustion exhaust gases and the water, between a cylinder cooling medium and the water, or directly between the cylinder material and the water.--

Please replace the paragraph beginning at page 11, line 14, with the following rewritten paragraph:

--The compression conditions vary between different engines and compressors, as well as the pressure and the temperature of the medium before compression. Upon the implementation of the invention, the conditions should, preferably, be such that there is an intersection similar to the one described above. With pre-compressed and pre-cooled air, which is common by combustion engines, the intersection may be at a compression pressure which is substantially higher than said [[4,5]] 4.5 bar. But if the condition is according to table 1, the region above the intersection at [[4,5]] 4.5 bar is interesting. Accordingly, the water should be introduced after that the compression pressure has past [[4,5]] 4.5 bar. Further, the water should be pressurized and should have a temperature

that results in it being depressurized and starting to boil immediately at the introduction. The introduction is preformed by spraying the water into the compression chamber through an inlet valve adapted for the purpose. The already small droplets of the spray will explode during the depressurisation and boiling, and become small water droplets that, on one hand, immediately evaporate and, on the other hand, evaporates during the following compression. A continued generation of compression heat will, accordingly, result in continued heating of non-evaporated water droplets and in a subsequent boiling and evaporation, and the heat used for the evaporation counteracts any further increase of the temperature of the medium. Accordingly, heat is drained off from the air under compression, for the generation of the water steam during the compression. Preferably, the control system according to the invention comprises sensors for sensing the pressure and the temperature in the compression chamber, as well as a control unit, which is operatively connected with these sensors and with the inlet valve, and provided with software constituted by a computer program that controls the liquid, the water, is to be injected upon basis of the information that it gets from the pressure and temperature sensors.--

Please replace the table beginning at page 13, line 18, with the following rewritten table:

-- Pressure condition	2-steps	3-steps	Isotherm
<del>20 bar</del>	<del>21.1%</del>	<del>26.8%</del>	<del>36.8%</del>
20 bar	21.1%	26.8%	36.8%
<del>25 bar</del>	<del>22.6%</del>	<del>28.7%</del>	<del>39.0%</del>
25 bar	22.6%	28.7%	39.0%--

Please replace the paragraph beginning at page 13, line 22, with the following rewritten paragraph:

--Table 2: Theoretic saving of power by cooled compression. Plural step adiabatic compression with inter cooling and isotherm compression. Reference: 1-step adiabatic compression. Kappa is [[1,4]] 1.4. The reference source is a preliminary study named ISOTHERM KOMPRESSION, by Jan-Gunnar Persson, 2000-01-16. The preliminary study has been done, under secrecy agreement, on the order of the present inventor. The report has not published.--

Please replace the paragraph beginning at page 13, line 30, and the table which follows the paragraph, with the following rewritten paragraph and table:

--Table 3 shows the largest possible heat absorption by means of evaporation at the intersection line according to table 1, compared to the need of cooling by isotherm compression from 1 to 25 bars. Further, it can be seen that the possible theoretical saving is 289/389 times the saving of power for an isotherm

compression, which, according to table 2, is 39% upon compression up to 25 bar. The saving that, theoretically, is possible by the implementation of the invention is, accordingly,  $289/389 \times 39 = 28.97\%$ ; this is comparable to the saving of power at the 3-step compression according to table 2. However, the invention makes it possible to perform the compression in one step, in one and the same cylinder, which is a remarkable advantage.

Temp (°K)	Steam pressure saturation (bar)	Heat of evaporation (kJ/kg)	Max heat absorption (kJ/kg)	Need of cooling by isotherm compression (kJ/kg)
<del>421</del>	<del>4.51</del>	<del>2119</del>	<del>289</del>	<del>389</del>
421	4.51	2119	289	389--

Please replace the paragraph beginning at page 14, line 17, with the following rewritten paragraph:



--Table 3: is a table that shows the maximum heat absorption per kg air at the intersection line according to table 1, compared to the need of cooling per kg air at isotherm compression from 1 to 25 bar. Table 3 also shows the maximum content of steam in air at a given pressure and temperature, in other words the condensation limit, according to an intersection line in table 1. Kappa is  $\frac{1}{1.4}$ . The reference source is the preliminary study named ISOTHERM KOMPRESSION, by Jan-Gunnar Persson, 2000-01-16.--

Please replace the paragraph beginning at page 14, line 26, with the following rewritten paragraph:

- Fig. 1a and 1b shows an engine cylinder A with a piston B in two positions, a lower position corresponding to the lower dead centre of the piston, and an upper position, approximately 65 crank angle grades before the upper dead centre. The cylinder A is provided with an injection valve C for the injection of pressurized and heated water D. The injection valve may be the same valve as the one that is occasionally used for the injection of fuel. The water and the fuel may be mixed and simultaneously injected, resulting in the fuel being pressurized and heated to the same level as the water. The engine is a 2-stroke or 4-stroke combustion engine with a compression ratio of 20: 1. The figure does not show self evident components such as inlet and outlet ports or inlet or outlet valves, any possible, separate fuel injection valve, or any possible sparking plug.

Before the compression stroke, with the piston B in its lower dead centre position, the cylinder A is supposed to be filled with air of approximately 1 atmosphere at a temperature of 300 K. Kappa is supposed to be  $[[1,4]]$  1.4. When the piston B is in its position 65 crank angle grades before its upper dead centre position, the compression pressure is approximately  $[[4,7]]$  4.7 bar and the temperature is approximately 465 K. If the invention is not implemented, the pressure and the temperature at the upper dead centre of the piston will be approximately 66 bar and 995 K respectively, and approximately 75% of the compression work would remain. From a position of approximately 65 crank angle grades before the upper dead centre and further on to the dead centre, the invention can, according to this example, be implemented. For example, a control system may be adapted to inject water with, in accordance with table 1, a temperature of 453 K and pressure of 40 bar when the compression pressure is 6 bar and the temperature is approximately 456 K, however without claiming that this setting is optimal. The large depressurisation, 40 bar in comparison to 6 bar, and the heat energy of the water at the moment of introduction of the water into the cylinder, results in a fierce boiling and, accordingly, a fine atomization, and generation of a water curtain, with a very large cooling surface area. A certain amount of the introduced water is immediately evaporated in a few microseconds, resulting in a temperature

reduction. A further evaporation takes place during the continued compression process.--